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Applicant:	Sidney Edward Fisher	
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Priority:	GB 0029058.5	Filed: November 29, 2000
Examiner:	Unknown	
Group Art Unit:	3682	
Title:	ACTUATOR	

TRANSMITTAL OF CERTIFIED COPY

Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

With regard to the above-referenced patent application, enclosed is a Certified Copy of prior corresponding document GB 0029058.5 filed November 29, 2000.

Respectfully submitted,

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Dated: December 19, 2001

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2. Patent application number *(The Patent Office will fill in this part)* 0029058.5

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Meritor Light Vehicle Systems (UK) Limited
Fordhouse Lane
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B30 3BW
United Kingdom

Patents ADP number *(if you know it)* 7342876001

If the applicant is a corporate body, give the country/state of its incorporation: United Kingdom

4. Title of the invention: Actuator

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

WITHERS & ROGERS
Goldings House
2 Hays Lane
London
SE1 2HW

Patents ADP number *(if you know it)* 1776001

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Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

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Number of earlier application	Date of filing *(day / month / year)*

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Continuation sheets of this form	
Description	12
Claim(s)	4
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JBJ/P300635GB

Actuator

The present invention relates to actuators, and in particular actuators for use in association of vehicle door locks such as car (automobile) door locks.

Known vehicle door locks actuators are required to provide an output position corresponding to an unlocked condition of the associated door and also an output position corresponding to a locked condition of the associated door.

Furthermore some vehicle door lock actuators are further required to provide an output position corresponding to a superlocked condition of a vehicle door.

For the avoidance of doubt, the term locked is used to mean that a door is unable to be opened from the outside but can be opened from the inside, and the term superlocked is used to mean a door which cannot be opened from either the inside or the outside.

An object of the present invention is to provide an improved form of actuator.

Thus according to the present invention there is provided an actuator including a motor in driving connection with a cam rotatable about a cam axis, the actuator further including a cam follower connected to an output member, in which powered rotation of the cam causes the cam follower to be radially displaced relative to the cam axis to provide differing output positions of the output member.

Advantageously such an arrangement can use one basic actuator assembly and by interchanging of the cam arrangement can provide for an actuator which locks/unlocks an associated door lock or alternatively locks/unlocks/superlocks and associated door lock.

Furthermore such an arrangement advantageously provides for a motor that only needs to be powered in one direction.

The invention will now be described, by way of example only, with reference to the accompanying drawings in which:-

FIGURE 1 is a view of an actuator according to the present invention,

FIGURE 2 is an exploded view of figure 1,

FIGURES 3 to 6 show an axial view of some of the components of the actuator of figure 1 in various position,

FIGURE 7 shows an axial view of the cam arrangement of figure 1 in isolation,

FIGURE 8 shows a partial view of figure 7,

FIGURE 9 is a view of a further actuator according to the present invention,

FIGURE 10 is an exploded view of figure 9,

FIGURES 11 to 16 show an axial view of some of the components of the actuator of figure 9 in various positions,

FIGURES 17 shows an axial view of the cam arrangement of figure 9,

FIGURE 18 shows an isometric view of an alternative cam arrangement for use in the actuator of figure 9.

With reference to figures 1 to 7 there is shown an actuator 10 including a housing 12, a motor 14, a pivot pin 16, a cam wheel 18 and an output member 20, a housing cover 22 and a spring 24.

Housing 12 includes a motor recess 26 and a cam wheel recess 28.

Motor assembly 14 includes a motor 30 driveably connectable to an output pinion 32 via a centrifugal clutch 34.

Cam wheel 18 includes an array of teeth 36 for engagement with output pinion 32, and a central hole 38 to allow the cam wheel to be pivotably mounted on pivot pin 16. Cam wheel 18 further includes a recess 40 which will be described further below.

Housing cover 22 is generally planar in form and includes a recess (not shown) within boss 42 to receive shaft 31 of motor assembly 14, a recess (not shown) corresponding to cam wheel recess 28, and a lever recess (not shown) within boss 44 to allow the output lever to rotate as will be described further below.

Output member 20 includes levers 46 and 48 and pivot pin 50. Lever 46 includes a cam follower 52 at one end thereof for engagement with recess 40 and a hole 54 at the other end thereof, profiled in such a manner as to engage end 50A of pin 50 in a press fit and rotationally fast manner.

Lever 48 includes a hole 56 at one end thereof connectable in use to a component (not shown) to be actuated. A hole 58 is positioned at the other end of lever 48, profiled to engage in a press fit manner and rotationally fast with end 50B of pivot pin 50.

Lever 48 further includes a spring hole 60 through which ends 24A of spring 24 passes. The other end 24B of spring 24 is inserted into spring hole 62 of boss 44.

When assembled:-

Motor assembly 14 sits in motor recess 26 with shaft 21 engaging and being supported by the hole within boss 42.

Cam wheel 18 sits in recess 28 and the corresponding recess (not shown) of cover 22 with the array of gear teeth 36 in engagement with pinion 32, and central hole 38 being mounted

on pivot pin 16 which in turn is mounted in hole 29 of housing 12 and a corresponding hole (not shown) beneath boss 44.

The output member is assembled such that a part of mid portion 51 of pivot pin 50 is pivotally mounted within hole 45 of boss 44, and spring 24 is mounted around an adjacent part of mid portion 51.

In particular spring 24 is arranged such that the output member 20 is biased in a clockwise direction when viewed in the direction of arrow A i.e. cam follower 52 is biased in a radially outward direction relative to the axis 16A of pivot pin 16.

When motor 30 is energised the centrifugal clutch 34 will engage, hence driving pinion 32 in an anticlockwise direction when viewed in the direction of arrow A causing the cam wheel to rotate in a clockwise direction when viewed in the direction of arrow A. This rotation of the cam wheel will cause the cam follower 52 to follow the profile of recess 40 and cause the output member to pivotally reciprocate as will be described further below.

Furthermore external reciprocation of the output member 20 (e.g. by manual reciprocation) will cause the cam follower 52 to drive the cam wheel 18 in a clockwise direction. Such rotation causes output pinion 32 to also rotate, though motor 30 is not rotated since the centrifugal clutch 34 is not engaged.

Consideration of figure 7 shows the cam wheel 18 in more detail.

In particular recess 40 includes an outer wall 70 and an inner wall 80 which together form a cam.

Outer wall 70 includes two first stops 71A and 71B both located at radius R1 from axis A.

Outer wall 70 further includes stops 72A and 72B, both located at radius R2 from axis A. Note that radius R2 is smaller than radius R1.

Stops 71A, 71B, 72A and 72B act to limit the outward movement of the cam follower.

The profile of the outer wall 70 between stop 71A and 72A is split into three distinct portions 73, 74 and 75.

Spirally curved portion 73 starts at stop 71A at circumferential position C1 and spirals inwards to edge 76A at radius R3 and circumferential position C2. It should be noted that radius R3 is less than radius R1.

For the avoidance of doubt term inward spiral refers to a curved traced by a point which rotates about a fixed position towards which it continually approaches, and the term outward spiral should be construed accordingly. In particular a straight line is a special form of curve and the term spiral curve includes for example and embodiment wherein stop 71A is connected to edge 76A by a straight line.

It should be noted that the exact form of spirally curved portion 73 can be varied, for example it could be part of an archimedian spiral, part of a circle, part of an ellipse, or other forms. The significant point is that point 76A is circumferentially displaced from stop 71A and is radially closer to axis A than stop 71A.

Portion 74 is substantially radially orientated.

Portion 75 comprises an outward spirally curved portion.

The portion of outer wall between stop 72A and 71B has equivalent inwardly spirally curved portion 77, substantially radially orientated portions 78 and outwardly spirally curved portion 79.

In particular it should be noted that portion 78 should be regarded as a substantially radially orientated portion even though in fact it is part of an arc, the centre of which is the axis of pivot pin 70 when the cam follower is situated adjacent this portion of the outer wall. The

form of portion 78 thus allows the cam follower to move substantially radially relative to axis A without causing the cam wheel to rotate.

Three corresponding portions (not marked for clarity) can be identified between stop 71B and stop 72B and three corresponding portions (not marked for clarity) can be identified between stop 72B and stop 71A.

With reference to figure 8 it can be seen that inner wall 80 includes third stops 81A, 81B, 81C and 81D, all positioned at radius R3 from axis A.

Consideration of the outer wall profiled between stop 81A and 81B shows a substantially radially orientated portion 82 and an inwardly spirally curved portion 83.

The profile of the inner wall between stops 81B and 81C includes a substantially radially orientated portion 84 and an inwardly spirally curved portion 85. Equivalent portions (not marked for clarity) can be identified between stops 81C and 81D and also between stops 81D and 81A.

It should be noted that the circumferential position C4 of inner stop 81B is circumferentially between the circumferential positions C1 and C3 of outer stops 71A and 72A respectively.

Furthermore it can be seen that the circumferential position C4 of stop 81b is circumferentially offset (mis-aligned) from edge 86 (positioned at circumferential position C5) edge 86 is also circumferentially offset from stop 72a (compare positions C5 and C3).

Powered operation of the actuator is as follows:-

Consideration of figure 3 shows the actuator in a stationary position with the cam follower 52 being biased in a radially outward direction by spring 24. Cam 52 is limited in its outward movement by engagement with stop 72A.

The motor is energised such that the cam wheel is caused to rotate in a clockwise direction whereupon portions 77, 78 and 79 progressively move past cam follower 52. As portion 77 moves pass cam follower 52 the cam follower progressively moves radially inwardly relative to axis A causing the output member 20 to rotate in an anticlockwise direction about axis B.

As the end of portion 77 adjacent portion 78 moves pass cam follower 52, the output member 'snaps' clockwise under the influence of spring 24 until such time as the cam follower 52 abuts the end of portion 79 adjacent portion 78. Continued rotation of the cam wheel 18 in a clockwise direction causes the portion 79 to move pass cam follower 52 until such time as the actuator achieves the position as shown in figure 4 whereupon cam follower 52 engages stop 71B.

It should be noted that due to the radial difference between stop 72A and 71B the output member 20 is in a different position when comparing figures 3 and 4. It should be noted that motor 30 is energised with a pulse of predetermined duration and provided that edge 76A has passed under cam follower 52 and provided that edge 76B has not passed under cam follower 52 then whenever the pulse of energy ceases with the cam follower between these two edges, the spring 24 will cause the cam wheel to return or advance to the position as shown in figure 4 since this is the radially outer most position achievable by the cam follower between edges 76A and 76B.

A further pulse of energy to motor 30 will cause stop 72B to move beneath the cam follower. Note that at this position the output member 20 will be in the position as shown at figure 3 but the cam wheel will be rotated 180 degrees from the position as shown in figure 3. A further pulse of energy to the motor will move stop 71A beneath cam follower 52 and a yet further pulse of energy will move stop 72A beneath cam follower 52 returning the actuator to the position as shown in figure 3.

Note that during powered operation cam follower 52 only need engage the outer wall 70 and no contact is required between cam follower 52 and inner wall 80.

It is possible to externally actuate the output member 20 to rotate the cam wheel 18 under these circumstances the sequence of movements are shown sequentially in figure 3, figure 5, figure 4 and figure 6.

Thus manual actuation of the output member 20 in an anticlockwise direction about axis B causes cam follower 52 to disengage the outer wall and engage the inner wall at portion 85, since edge 86 is circumferentially offset from stop 72A. Continued anticlockwise movement of output member 20 results in cam follower 52 moving substantially radially inwardly relative to axis A causes a camming action between cam follower 52 and portion 85 resulting in clockwise rotation of cam wheel to the position as shown in figure 5, whereupon cam follower 52 engages stop 81C.

Release of output member 20 results in output member snapping clockwise under the influence of spring 24 until such time as cam follower 52 engages an end of portion 79 of the outer wall. Spring 24 continues to basis cam follower 52 in a radially outward direction resulting in the camming action between cam follower 52 and portion 79 until such time as the actuator achieves the position as shown in figure 4.

A further manual actuation of the output member in an anticlockwise direction about axis B causes cam follower 52 to disengage the outer wall and engage the inner wall at portion 80 causing the actuator to move to the position as shown in figure 6. Subsequent release of the output member will cause this component to move to the position as shown in figure 3 under the influence of spring 24 (though it should be noted that the cam wheel will be positioned 180 degrees from the position as shown in figure 3).

Thus it can be seen that progressive pulses of energy to the motor can cause the output member to move between the position as shown in figures 3 and 4. Furthermore the output member can be caused to move between these two positions by successive manual or other external actuation of the output member 20.

As mentioned above, the spring 24 acts to bias the cam follower radially outwardly relative to the cam wheel axis. A person skilled in the art would readily appreciate that it is also

possible to arrange the spring to bias the cam follower radially inwardly and to provide an appropriate cam formation. It will be noted that claim 3 to 18 are all dependent at least upon claim 2 which defines the cam follower being biased radially outwardly relative to the cam axis. A similar set of claims could be provided dependent upon claim 19 which defines the cam follower being biased radially inwardly with the set of claims being suitably modified to account for the different in biasing of cam follower.

With reference to figures 9 to 16 there is shown a second embodiment of an actuator 110 in which components which fulfil substantially the same function as those in actuator 10 are labelled 100 greater.

Note that recess 140 is of a different profile to recess 40.

Furthermore housing pivot 122 does not include a hole equivalent to spring hole 62 and lever 148 does not include a hole equivalent to spring hole 60. However, housing cover 122 does include a projection 90 having sides 90A and 90B separated by distance W and lever 148 includes a tab 91 having sides 91A and 91B also separated by width W.

Spring 124 has ends 124A and 124B which are generally tangentially orientated relative to the body of spring 124 with end 124A lying adjacent side 90A and 91A and end 124B lying adjacent side 90B and 91B when assembled (see figure 9). The combination of projection 90, tab 91 and spring 124 act to bias tab 91 in line with projection 90. Thus if lever 148 where to be biased clockwise when viewing figure 10 in the direction of arrow D, edge 91B would engage and move end 124B clockwise whilst end 124A of spring 124 would engage stationary edge 90A. This results in winding up of spring 124 which in turn biases lever 148 to a position such that projection 90 aligns with tab 91. Clearly rotation of lever 148 anticlockwise when viewing figure 10 in the direction of arrow D causes edge 91A to engage and move end 124A whilst end 124B engages stationary edge 90B of projection 90. This again causes spring 124 to be wound up and hence the spring biases lever 148 to a position such that projection 90 aligns with tab 91.

Figures 11, 13 and 15 show the position of the output member 120 when tab 91 is aligned with projection 90.

Consideration of figure 17 shows that recess 140 includes outer wall 170 and inner wall 180.

Outer wall 170 includes stops 92A, 92B and 92C, substantially radially orientated portions 93A, 93B and 93C and spirally curved portions 94A, 94B and 94C. It should be noted that spirally curved portions 94A and 94C spiral outwards whilst spirally curved portion 94B spirals inwardly.

Inner wall 180 includes stops 95A, 95B and 95C substantially radially orientated portions 96A, 96B and 96C and spirally curved portions 97A, 97B and 97C. It should be noted that spirally curved portions 97A and 97C spiral outwards whilst spirally curved portion 97B spirals inwards.

Powered operation of the actuator is as follows:-

With the actuator in the position as shown in figure 11 the cam 152 abuts stop 92C. Powering of the motor causes the cam wheel 118 to rotate anticlockwise such that spirally curved portion 97C engages and cams out cam follower 152.

Output member 120 will momentarily achieve the position as shown in figure 12 following which it will snap back to the position as shown in figure 13.

A subsequent energisation of the motor will again rotate the cam 180 anticlockwise when viewing figure 13 whereupon cam follower 152 will engage with and be cammed out by spirally curved portion 97A. The output member 120 will momentarily achieve the position as shown in figure 14 following which it will snap back to the position as shown in figure 15 under the influence of spring 124.

A further energisation of the motor will again cause the cam wheel 118 to rotate anticlockwise following which the cam follower 152 will engage and be cammed inwardly by spirally curved portion 94B of the outer wall 170. The output member 120 will momentarily achieve the position as shown in figure 16, following which it will snap back to the position as shown in figure 11.

Note that in moving between the positions as shown in figures 11, 12 and 13 the output member moves clockwise and anticlockwise, in moving between the position as shown in figures 13, 14 and 15 the output member moves clockwise then anticlockwise, but in moving between the position as shown in figures 15, 16 and 11 the output member initially moves anticlockwise and then moves clockwise. Furthermore the output member 120 has moved further clockwise in figure 12 than in figure 14.

It is also possible to externally actuate the output member 120 e.g. by manual operation. Thus starting at figure 11 manually moving the output member 120 clockwise about axis E of pivot pin 150 causes the actuator to move to the position as shown in figure 12 subsequent release of the output member 120 causes the actuator to move (snap) to the position as shown in figure 13. Subsequent clockwise rotation of output member 120 causes the cam follower 152 to engage spirally curved position 94A resulting in the actuator moving to the position as shown in figure 14. Subsequent release of the output member 120 causes the actuator to move (snap) to the position as shown in figure 15. Subsequent manual rotation of the output lever 120 in an anticlockwise direction causes the cam follower to engage spirally curved portion 97B and move to the position as shown in figure 16. Subsequent release of the output member 120 causes the actuator to move (snap) to the position as shown in figure 11.

Consideration of figure 18 shows an alternative cam wheel 218 suitable for use in the actuator 110. In this case recess 240 is of a differing profile and in particular is rotationally symmetrical through 180 degrees, i.e. the view shown in figure 18 is identical the same view when the cam wheel has been rotated through 180 degrees.

Outer wall 270 includes an diametrically opposed stops 1A and 1B and diametrically opposed stops 2A and 2B. The outer wall 279 further includes substantially radially orientated portions 3A, 3B, 4A and 4B the outer wall further includes inwardly spirally curved portions 5A and 5B and outwardly spirally curved portions 6A and 6B. Corresponding stops, substantially radially orientated portions and spirally curved portions can be found on inner wall 280.

When cam wheel 280 is used in the actuator 110 in place of cam wheel of cam wheel 118 it provides for two 'momentary' output positions of the output member 120 (rather than the three 'momentary' positions as shown in figures 16, 12 and 14 when using cam wheel 118). This is because of the 180 degree rotational symmetry of cam 218. Thus for example the stops 1A and 1B are positioned at the same radius and stops 2A and 2B are also positioned at the same radius (though different from the radius of stops and 1A and 1B). The two 'momentarily' output positions associated with cam wheel 218 are positioned one on either side of the rest position of the output member 120, i.e. the position to which it is biased towards bias spring 124.

Any form of motor can be used but in particular DC electric motors are particularly suitable as are electric stepper motors.

The embodiments thus far described show a cam follower in the form of a pin which is positioned in a groove which provides for the cam profile. In further embodiments different cam profile and cam follower arrangements could be used in particular a twin pronged fork cam follower could be used with a fork being provided on either side of a rail, the rail being shaped to provide the cam profile.

Claims

1. An actuator including a motor in driving connection with a cam rotatable about a cam axis, the actuator further including a cam follower connected to an output member, in which powered rotation of the cam causes the cam follower to be radially displaced relative to the cam axis to provide differing output positions of the output member.
2. An actuator as defined in claim 1 in which the cam follower is biased radially outwardly relative to the cam axis.
3. An actuator as defined in claim 1 or 2 in which the cam has a first stop to stop the cam follower at a first radius and a second stop to stop the cam follower at a second radius the stops acting to limit the radially outward movement of the cam follower.
4. An actuator as defined in claim 3 in which the cam profile between the first and second stops is profiled such that the cam follower moves to a radius which is smaller than both the first and second radius.
5. An actuator as defined in claim 3 or 4 in which the cam profile between the first and second stops includes a spirally curved portion.
6. An actuator as defined in claim 5 in which powered operation of the actuator causes the cam follower to move radially inwards when engaging the spirally curved portion.
7. An actuator as defined in claims 3 to 6 in which the cam profile between the first and second stops includes a first substantially radially orientated portion to allow the cam follower to move radially outwards relative to the cam axis.
8. An actuator as defined in any preceding claim in which the cam further includes a third stop to stop the cam follower at a third radius for limiting the radially inward movement of the cam follower.
9. An actuator as defined in claim 8 in which the third stop is circumferentially between the first and second stops.
10. An actuator as defined in claim 8 or 9 in which the third stop is substantially opposite the confluence of the first substantially spiral portion and the first substantially radially orientated portion.
11. An actuator as defined in claims 8 to 10 in which a portion of the cam profile adjacent the third stop includes a second substantially spirally curved portion opposite the first substantially spirally curved portion.

12. An actuator as defined in claim 8 to 11 in which a portion of the cam profile adjacent the third stop includes a second substantially radially orientated portion opposite the first substantially radially orientated portion.

13. An actuator as defined in claim 11 and 12 in which confluence of the second substantially spirally curved portion and the second substantially radially orientated portion is circumferentially mis-aligned with the first or second stop.

14. An actuator as defined in any preceding claim in which external actuation of the output member causes rotation of the cam.

15. An actuator as defined in claim 14 when dependent upon claim 2 in which the output member is operated to move the cam follower radially inwardly.

16. An actuator as defined in claim 14 in which the output member is operated such that the cam follower engages the third stop.

17. An actuator as defined in any preceding claim in which the first and or second stops acts to prevent backward movement of the cam wheel.

18. An actuator as defined in any preceding claim in which there is a plurality of first and/or second and/or third stops.

19. An actuator as defined in claim 1 in which the cam follower biased radially inwardly.

20. An actuator as defined in claim 1 in which the cam follower is capable of moving between an radially outer position and a radially inner position and the cam follower is biased to a bias position radially between the radially outer and radially inner position.

21. An actuator as defined in claim 20 in which the cam has an outward stop which acts to limit the radially outward movement of the cam follower.

22. An actuator as defined in claim 20 or 21 in which the cam has an inward stop which acts to limit the radially inward movement of the cam follower.

23. An actuator as defined in claim 21 and 22 in which the cam profile between the outward stop and inward stop includes a spirally curved portion.

24. An actuator as defined in claims 20 to 23 in which powered operation of the actuator causes the cam follower to move radially outwards or radially inwards.

25. An actuator as defined in claims to 20 to 23 in which the cam profile between the outward stop and the inward stop includes a substantially radially orientated portion to allow cam follower to move substantially radially relative to the cam axis.

26. An actuator as defined in claims 20 to 25 in which the cam profile includes a return stop to prevent the backward rotation of the cam past the return stop.

27. An actuator as defined in claim 26 in which the return stop is substantially circumferentially in line with the outward stop or the inward stop.

28. An actuator as defined in claims 20 to 27 in which external operation of the output member causes rotation of the cam.

29. An actuator as defined in claim 28 in which the output member is moved away from its biased position by the external operation to rotate the cam.

30. An actuator as defined in claim 29 in which the external operation of the output member is such that the cam follower engages the output or inward stop.

31. An actuator as defined in claims 20 to 30 including a plurality of outward stops and/or a plurality of inward stops and/or a plurality of returns stops.

32. An actuator as defined in claim 31 in which a first outward stop is positioned a different radius to a second outward stop.

33. An actuator as defined in claim 31 in which a first inward stop is positioned at a different radius to a second inward stop.

34. An actuator as defined in claim 31 in which a first return stop is positioned at a different radius to a second return stop.

35. An actuator as defined in any preceding claim in which the motor is powered in a single direction to provide for the differing output positions of the output member.

36. An actuator as defined in any preceding claim having a powered position corresponding to each of the output positions of the actuator.

37. An actuator as defined in any preceding claim having an at rest position differing from the powered output position of the actuator.

38. An actuator as defined in any preceding claim for use in a vehicle door locking system to provide locking and unlocking of a vehicle door lock.

39. An actuator as defined in claim 38 further providing for superlocking of the vehicle door lock.

40. An actuator as defined in any preceding claim in which the output positions of the output member are located on an arc of a circle.

41. An actuator as defined in any preceding claim in which the motor is connected with the cam via a centrifugal clutch.

42. An actuator as defined in any preceding claim in which the motor is connected with the cam via a gear and pinion arrangement.

43. An actuator as defined in claim 42 in which the gear is integral with the cam.

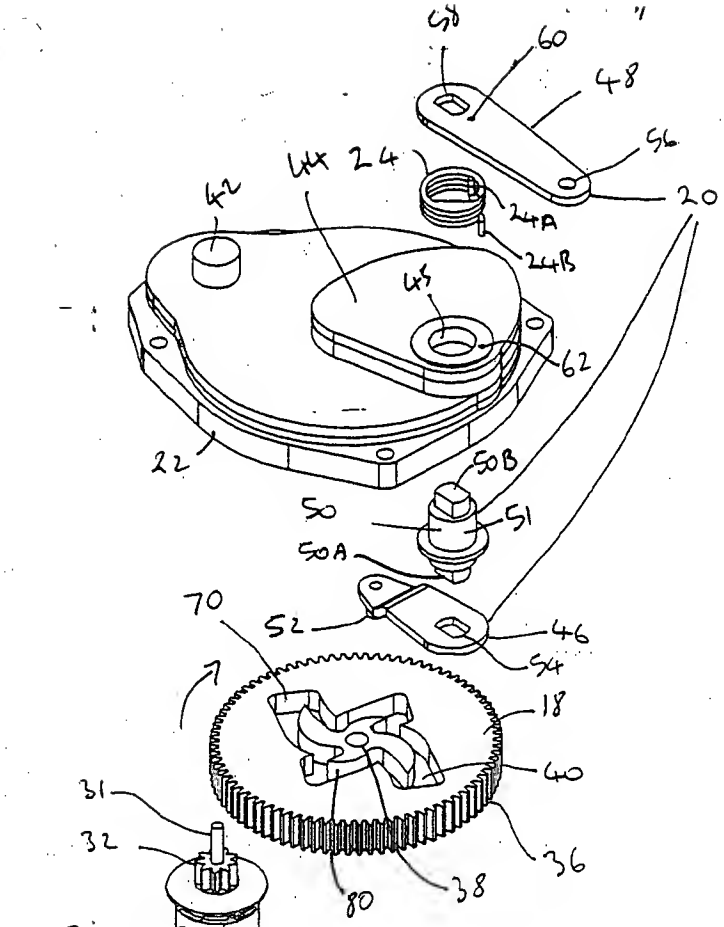
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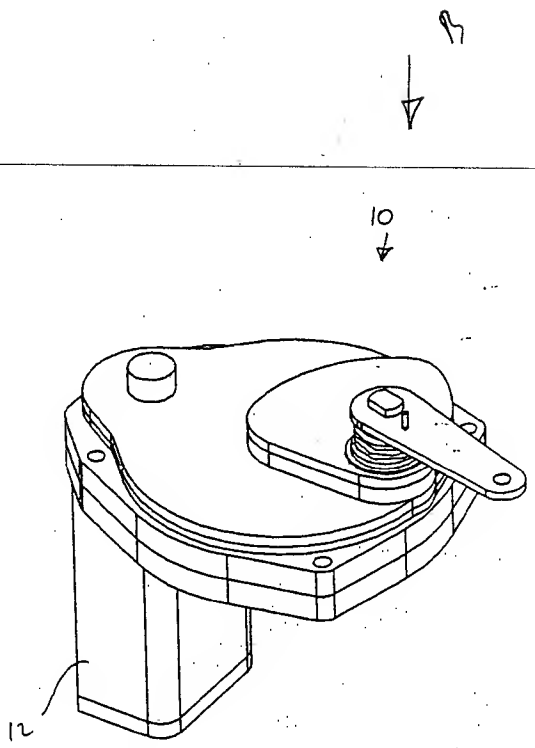
FIG 2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12

FIG 1

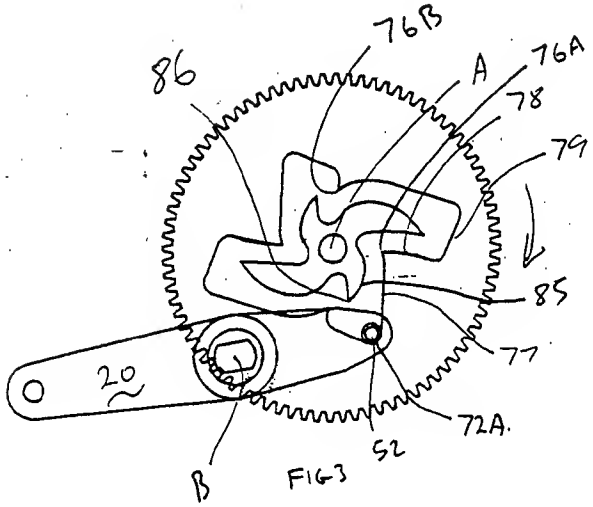

FIG 3

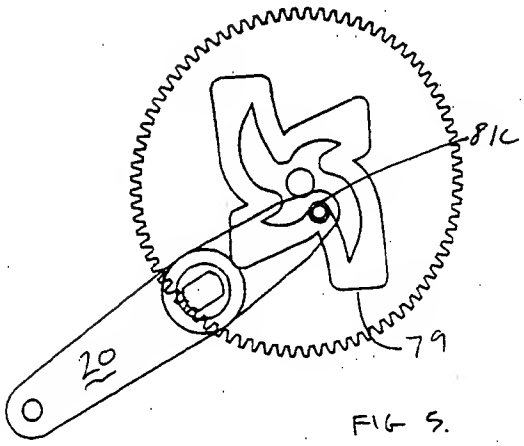

FIG 5.

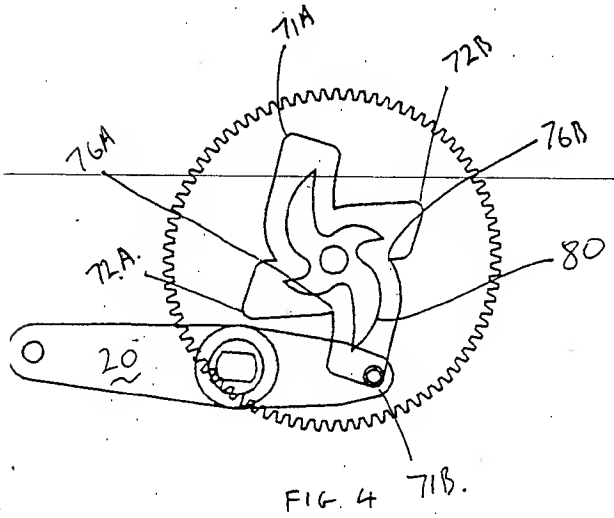

FIG. 4

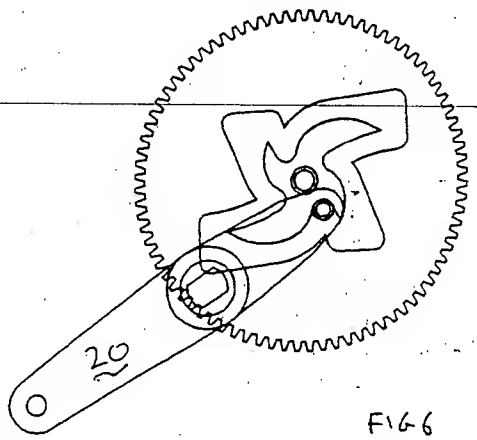

FIG 6

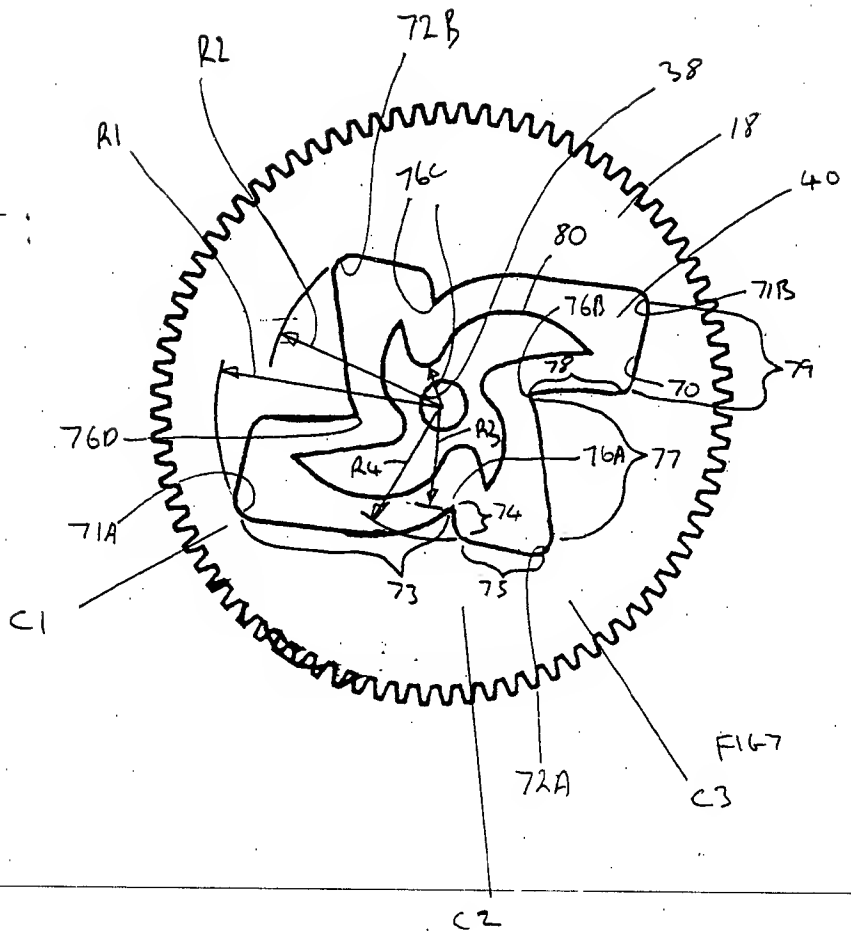
72B
R2
38
R1
18
76C
40
80
71B
76B
79
78
70
76D
R3
R4
76A
77
74
71A
73
75
C1
72A
C3
C2

FIG 7

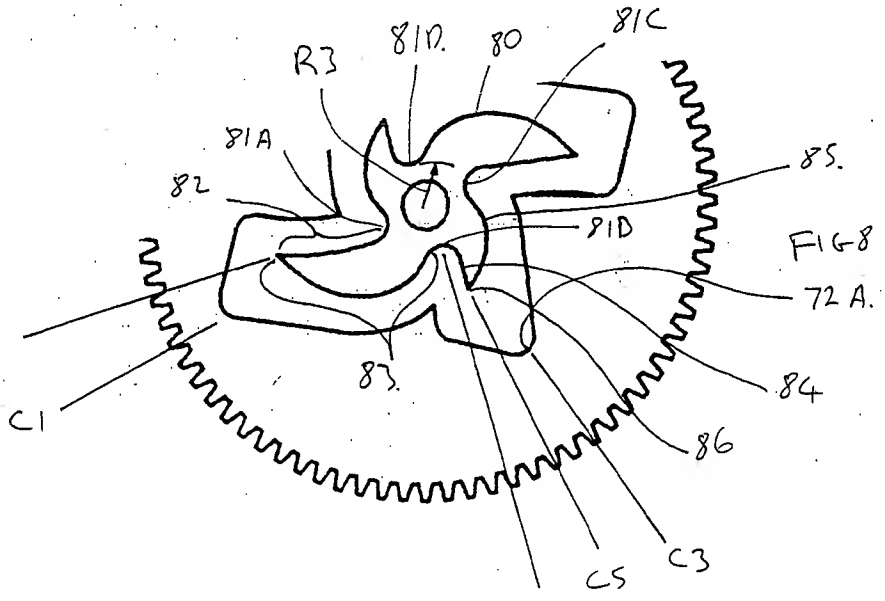
81C
81D.
80
R3
81A
85.
82
81D
72A.
84
83.
86
C1
C5
C3

FIG 8

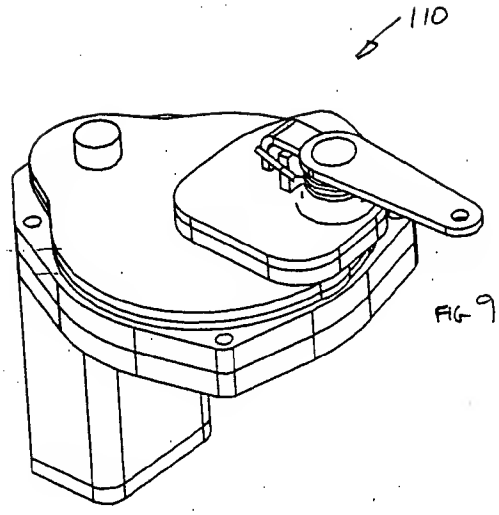

FIG 9

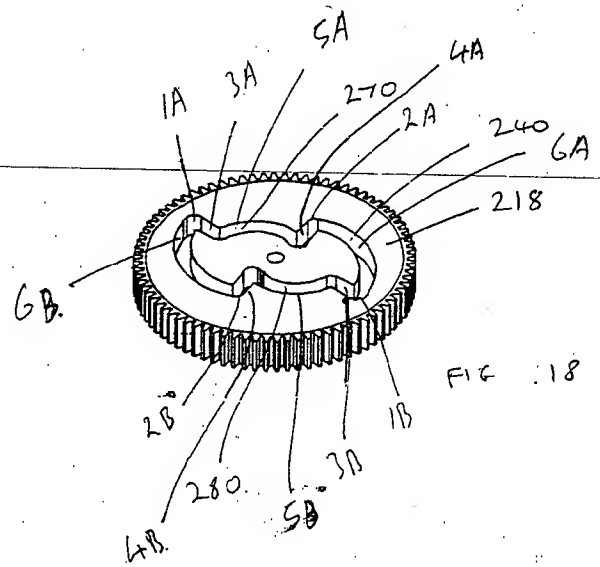

FIG 18

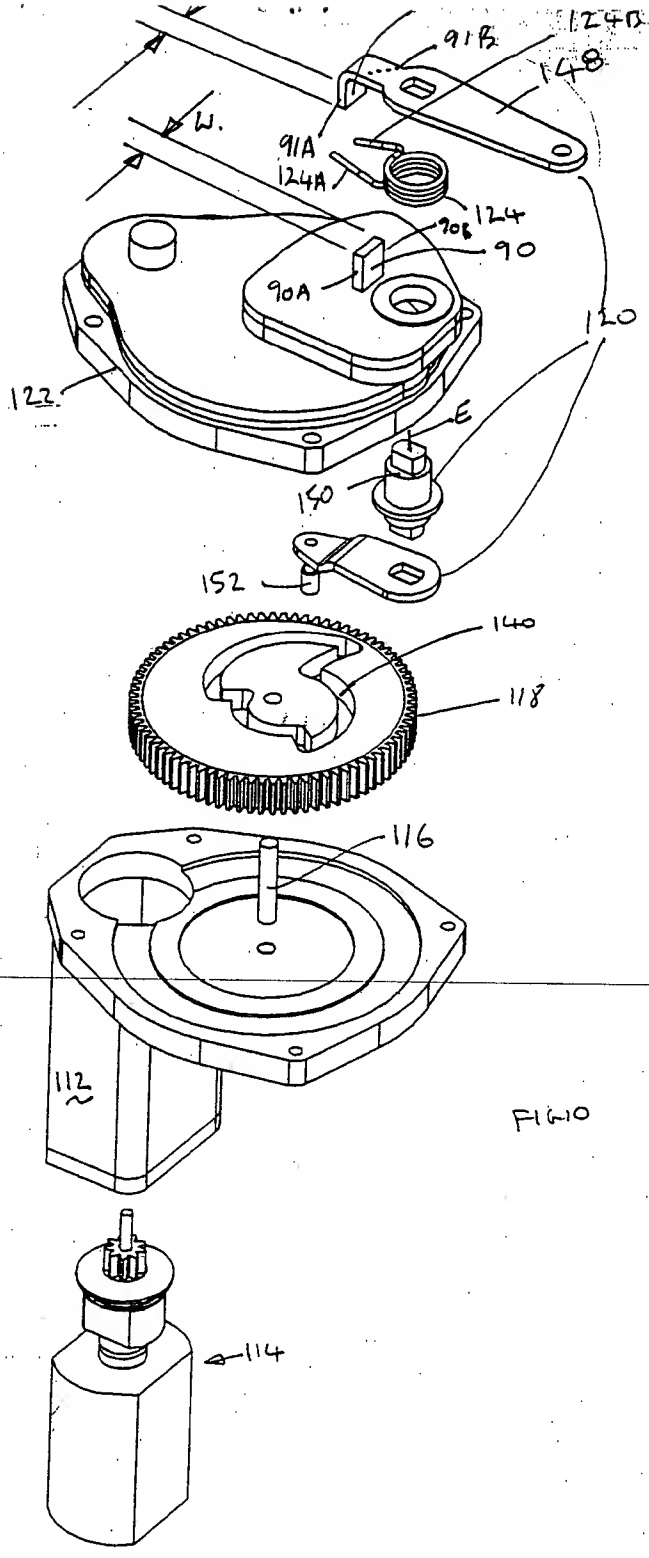
124B
91B
148
W.
91A
124A
124
90B
90
90A
120
122
E
150
152
140
118
116
112
114

FIG 10

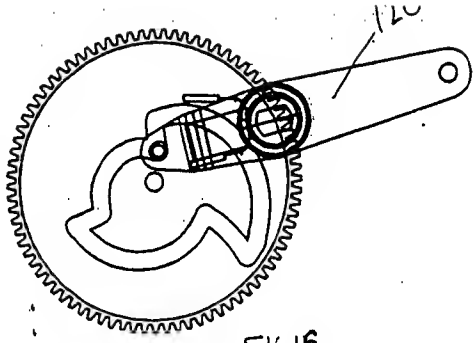

FIG16

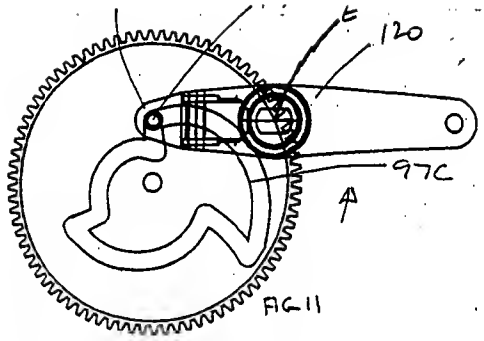

FIG11

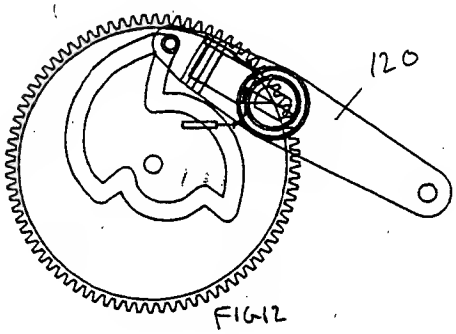

FIG12

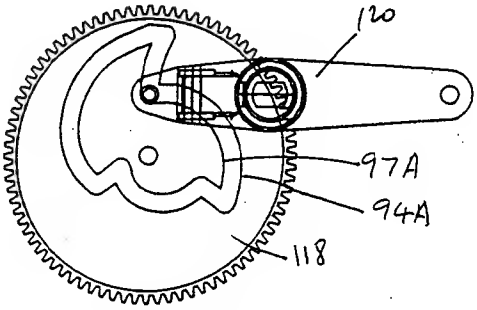

FIG13

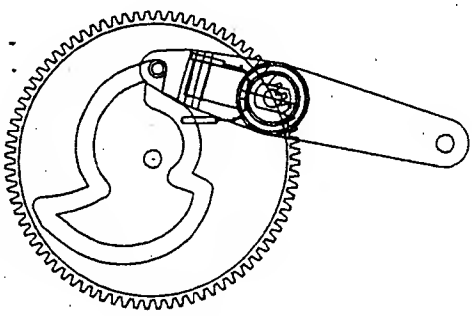

FIG14

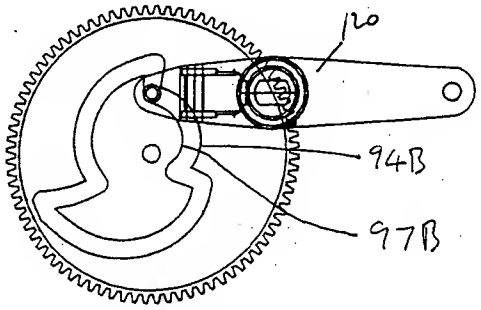

FIG15

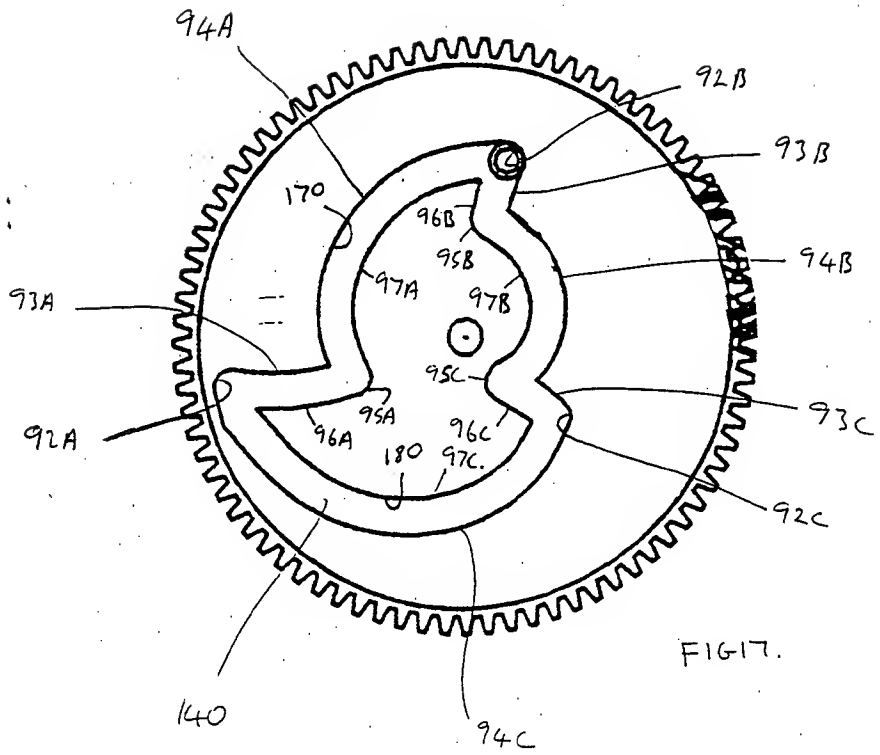
94A
92B
93B
170
96B
95B
94B
93A
97A
97B
95C
93C
92A
95A
96A
96C
180
97C.
92C
140
94C

FIG17.